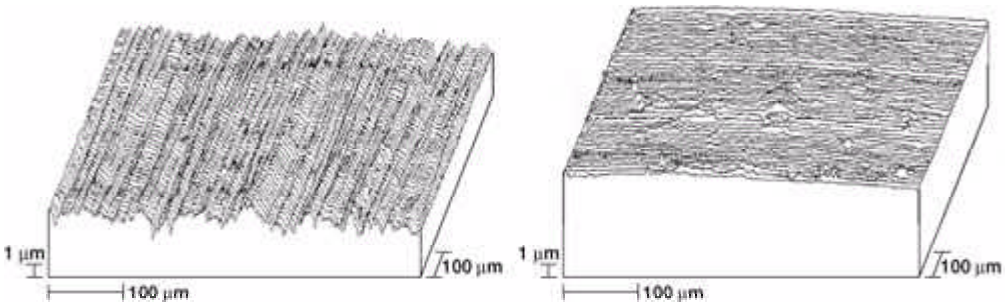
Metrology Evaluation of Superfinished Gears Completed

Gears, bearings, and similar mechanical elements transmit loads through the surfaces that are in contact with one another. Thus, the fatigue lives of gears can be improved by providing smoother tooth surfaces. At the NASA Lewis Research Center, we completed a metrology evaluation of one method for making gears with a highly polished, mirrorlike surface (see the following photo). The polished gears were measured carefully. The measurement data showed that the polishing process did, indeed, reduce the surface roughness but did not change the overall tooth shape in any harmful way.

Highly polished surface of superfinished gears.

This work was done as a partnership of NASA, the U.S. Army, and the University of Wales. NASA provided conventionally ground gear specimens and has begun testing to determine the fatigue lives of the superfinished gears. Under contract, the University of Wales superfinished the gears and inspected them before and after the superfinishing operation. The U.S. Army European Research Office provided the funds and procured the contract with the University of Wales.

For gears, the rate of fatigue is greatly affected by the ratio of the oil film thickness to the roughness of the contacting surfaces. In this work we are seeking to improve fatigue lives by reducing the surface roughness. Conventionally ground, aerospace quality gears were manufactured, and their geometry was inspected. Next, the gears were superfinished by placing them in a vibrating bath consisting of water, detergent, abrasive powder, and small pieces of zinc. Upon removal from the bath, the surfaces were highly polished (see the preceding photo). The gears were then again inspected, and the measurements of the gears before and after the superfinishing operation were compared. Typical inspection data are provided in the following plots. The grinding marks are clearly evident in the figure on the left. Superfinishing removed the peaks of the grinding marks and left a much smoother surface as is evident in the figure on the right. Profile and spacing checks proved that the overall gear tooth shape was not affected in any harmful way. Superfinishing uniformly removed approximately 2.5 μm from each surface. See reference 1 for a complete report.



Profile of tooth surfaces. Left: Ground. Right: Superfinished.

Reference

1. Snidle, R.W.; Evans, H.P.; and Alanou, M.P.: The Effect of Superfinishing on Gear Tooth Profile. Report AD-A327916, June 1997. (Available from the Defense Technical Information Center (DTIC) (http://www.dtic.mil/) or the National Technical Information Service (NTIS) (http://www.ntis.gov/), or the Center for AeroSpace Information (http://www.sti.nasa.gov/rselect/FAQ.html - docorder).

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